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Investigation of mechanical properties, thermal and electrical conductivity of multi-walled carbon nanotubes reinforced with Al2024 nanocomposites

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Abstract

In the present research work, multi-walled carbon nanotubes (MWCNTs) were reinforced with Al2024 alloy has been developed via powder metallurgy technique. MWCNTs are taken in a weight percentage of 1%, 2%, and 3% were mixed in a planetary ball mill. Further, the mixture was compacted, sintered, and heat-treated for the evaluation of various properties. The density of the nanocomposite was found to be decreased by 4.8%, whereas porosity by 3.04% due to the incremental addition of MWCNTs. Hardness increases by 9.77% and tensile strength increase 17.39 % due to the reinforcement of MWCNT percentages. The thermal conductivity decreases by 30.53% in a sintered and 77.89% in a sintered-heat treated composite. The decreasing trend in electrical conductivity has been observed with an increase in the quantity of MWCNTs from 55.88% to 45.45% in sintered and sintered-heat treated composite respectively. The morphological, the elemental study, and uniform dispersion of the MWCNTs reinforced Al2024 were observed and analyzed using SEM, TEM, XRD, and EDS.

Keywords

Al2024; Multiwalled carbon nanotubes; Mechanical properties; Thermal property; Electrical property

1. Introduction

Aluminium is a low density, high strength material, finds its usage in industrial applications such as cryogenic, automotive, and marine because of its mechanical, thermal, electrical, corrosion resistance, and optical properties [1], [2], [3], [4], [5], [6], [7]. Several researchers have developed aluminium metal matrix composites for enhancing various properties by mechanical processes such as extruding, heat-treating, and compacting. Aluminium as a versatile lightweight material can flow all along its molecular level by thermal and mechanical loading for changing its physical shape and crystalline structure. When measured by equal cross-sectional area, the aluminium has higher thermal conductivity compared to annealed copper [8]. Hence, this has been used for reinforcing with ceramics and other elements for aero applications. After the introduction of carbon nanotube by Iijima [9]. CNT has been used as a reinforcing material in aluminium and other metal matrices for composite development because of its high strengthening effect and flexibility in bending of nanotubes due to reversible